Photometric Precision of Backside-Illuminated CCD Arrays

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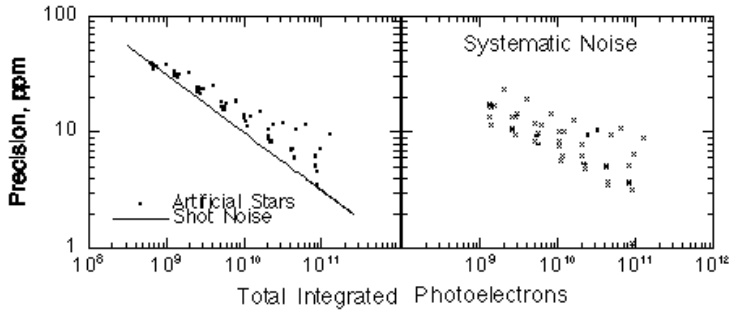
Limitations in the photometric precision of CCD arrays are an important consideration for the proposed Kepler mission to detect photometric signatures of extrasolar planetary transits. We have examined a 512x512 delta-doped, thinned, backside-illuminated Reticon CCD under controlled laboratory conditions simulating those expected for the Kepler mission. The CCD is mounted on a micropositioning stage to simulate pointing errors aboard the spacecraft. Due to delta-doping, no UV flooding is necessary for its operation and the QE is stable. An LED illuminates a perforated plate, focusing a star pattern on the CCD at a focal ratio of f/8. The entire system is contained in a temperature-controlled enclosure to ensure mechanical stability. Images are read out every 3 sec with 2.5 s exposures and 0.5 s readout time. No shutter is used and the CCD is illuminated continuously. Each frame is the sum of 45 individual images, and each star is approximately 7 pixels wide, resulting in 5.4×10^8 e^- per star per frame. The flux from each star is normalized by the sum of the fluxes of the other stars, and is then corrected for motion and nonlinear CCD response as per Robinson et al (1994). We repeatably obtain an average systematic error contribution to the total precision of 7×10^{-6} at a flux of 10^{10} e^-, demonstrating that systematic CCD errors will not seriously affect the Kepler mission.



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